THE TELEGRAPHIC JOURNAL.

Vol. I.—No. 13.

PRIZES TO STUDENTS.

We notified, in our last number, that it has been decided to offer our students a series of prizes for communications describing original experiments.

The communications which have hitherto reached us from our students, although in themselves of a highly satisfactory nature, appear with few exceptions to emanate more from their pens than from their experiences, and to be too often based upon a desire to quibble with accepted interpretations of experiments which others have made rather than evincing any desire to experiment themselves. It is of course much easier, for instance, for a student to sit down with an imperfect knowledge of Ampère's laws and to write an article to prove Ampère to be incorrect than it is for him to put the doubts suggested by his deficient knowledge to the test of experiment, and so prove himself to be a wise student.

Now we do not think that mere scribbling is an ambition worthy of an English student, and would rather see his energies take a more practical turn. We are aware, of course, that original experiments necessitate apparatus, and apparatus entails expense. We, therefore, the more readily fall into Mr. Sabine's suggestion, to offer to our students, from time to time, prizes in money sufficient to cover a moderate outlay in apparatus.

We announced last fortnight our first prize to be £25, and the subject of competition to be a clear and concise statement of evidences of the theory of conservation of energy as applied to electricity and magnetism.

We do not intend to hamper the competitor for this prize either by prescribing the nature of his experiments, the treatment of his subject, or his scientific belief. If he is a believer in the new theory, he will find the best support in the writings of such men as Joule, Tait, Grove, and other high priests of modern electrical belief. If he is a sceptic, he will find Neumann, Edlund, and other electrical free-thinkers. We do not intend to limit the free scope and honest expression of the student's thought by confining him to the orthodox views. His paper will be equally welcome whatever his opinions may be, so long as they are based on the rational interpretation of rational experiment.

The student would do well to bear in mind that he has no right to assert that which he cannot prove. At the same time he has equally no right to deny that which he cannot disprove. Now, we want our students to take this stand-point, and from it to build themselves up an electrical belief, and not to take a ready-made one and deck themselves out in other people's opinions, like daws in other bird's feathers. Tyndall would say, "Electricity is a force—a mode of motion of material atoms;" Neumann would say, "Electricity is a fluid—an actual material." Our advice is, Don't believe or disbelieve either of them till you have enquired for yourself.

The theory of the immateriality of electricity is very beautiful; but it has defects. Further research will doubtlessly supply these apparent defects; but until further research has done so, it can only be cautiously received. In the production of other forces by electrical force, and of electrical force by other forms of force, conditions arise which render it difficult to arrive at concordant expressions of their respective equivalents. Thus, if a known power be employed, and disappear in driving the best constructed magneto-electric machine, a certain force of current will be obtained. If this current be made to drive in turn the best constructed electro-magnetic engine, or perform some other measurable work, this final work is so insignificant in comparison with that originally employed to produce it, that we might be led to imagine, either the theory of the conservation of energy is misapplied to electricity, or in the process the greater part of the force is expended in by-ways, leaks out, and is lost to us. The latter view may be correct, and if so points rather to the shortcomings of our mechanical arrangements than to those of the conservation theory, and any determination of the equivalents therefore in this way could only be of limited value. Nearly the whole of a given quantity of heat may be converted into mechanical energy; and nearly the whole of a given quantity of energy may be converted into heat. Therefore the determination of their reciprocal equivalents is comparatively easy, and the result conclusive in favour of their relationship. But with electricity the case is different. Every electric current produces heat, and at the same time exerts magnetic force. Therefore an electric current cannot be converted wholly into either of them independently of the other.

In dealing with this question, results of experiments have been sometimes adopted as evidence which are really of little value. Such, for instance, is the observation that if an electric current be transmitted through a wire, the wire quickly becomes heated sometimes to incandescence, and simultaneously the current is weakened. This points favourably, it is true, at first sight towards the probability of the direct conversion of electricity into heat; for as the one appears the other disappears. It is nevertheless far from a complete proof. For if energy were used to pump air or water through a tube, the tube would become also slightly heated, without either air or water being transformed into heat. And this warmth might be measured, but it could by no means be called an expression of the thermal equivalent of atmospheric air or of pump water. And again when the point of junction of two different metals is heated above the temperature of the rest of the circuit we get a thermo-electric current. But as we get equal quantities of positive and negative electricity, no heat can in this case be transformed into electricity; because we get only as much out of one side of it as goes in at the other, which would not be the case if any transformation took place, otherwise than the transformation into mechanical effect in working the electric pump. Let us not be misunderstood to imply a belief in the materiality of electricity; we wish only to point out the want of a sufficient proof to the contrary, and to caution our students against the hasty adoption of theories, because they are pretty or because they are fashionable.

Let the student begin his task with a mind as little biassed as possible and firmly directed towards the sole object of finding out the truth, whatever direction truth may take; rather as a juryman than as an advocate. Let him begin this task also with a clear understanding that by analogy he will get little help; because electricity, if a force, differs from every other force with which we are acquainted, in not being producible without its negative. Heat we can store up, render dormant, reproduce without the simultaneous production of cold; light we can produce without producing darkness with it; but the moment positive electricity is produced, that same moment, measure for measure, negative electricity is also produced. If a material, it is one which differs from every other material in its impalpability, its universality, and the energy, sometimes enormous, it carries with it. Yet that it differs from known forces is no argument that it is not a force; nor is its difference from the materials with which our limited sphere has put us in immediate contact any argument that it may not be a material.

We promised in our last number to give the student some idea of the kind of experiments we should make if we were ourselves competing for this prize.

Starting with the assumption that the difference between positive and negative electricity* is the difference between a surplus and a deficiency, we should proceed to find out in what forms of electrical producers evidence of generation were observable. Whatever form of electrical producer we set in action, whether frictional machine, galvanic battery, thermo-battery, magneto-electrical machine, or what-not, it must be regarded either in the light of a *generator*, or a *pump*, or of a combination of both. That is to say, either the current or charge of electricity is generated, that is, transformed out of something else into electricity, wholly or in part within the machine itself; or the machine is simply a contrivance by means of which electricity is transferred from one side of it to the other; or it is a pump in which generation as well as transfer takes place. Any generation taking place within the machine itself would obviously produce an excess on one side without necessarily resulting in any deficiency at all on the other. A state of things which is certainly at variance with all our observations of the behaviour of electricity. Whereas, if the machine act as a pump, a surplus and its corresponding deficiency must always take place.

Now, in those electrical producers in which we find, after setting them in action for a given time, that the quantity of positive electricity on one side is exactly equal to the negative on the other; in other words, that exactly as much has gone in one side as has come out at the other, it is quite obvious that neither has any of the electricity remained back in the machine, nor has any been generated within it; in fact, that it has simply acted the part of a pump. In those electrical producers in which the student finds more positive than negative, or more negative than positive, he will have evidence that some transformation into or out of electricity has taken place.

The experiment we should make to classify the various forms of producer in this regard would be to simultaneously connect two condensers of large capacity with the two poles of the producer under examination having a great resistance, and after a given time, to discharge them simultaneously through two galvanometers. When reduced for the various constants of the instruments, the quantities of positive and negative electricity given off in the time may be readily compared.

Another experiment we should make would be with a heated wire. We should take a cell or two of large surface, and connect in its circuit a tangent galvanometer and a platinum wire of such length that in air it would become incandescent by the current. We should let the current flow, say ten minutes, whilst the wire was incandescent, and observe the needle of the galvanometer. We should then let the current flow another ten minutes, whilst the platinum wire was immersed in pounded ice, and observe the needle. *But immediately before and after each of these periods we should wash, dry, and weigh the zinc plates of the cells.* Faraday has shown that the quantity of electricity produced in a circuit is directly proportional to the quantity of zinc (or other material) dissolved. Now, if in making this experiment you were to find that the quantity of zinc dissolved remains constant, that is, that the same quantity of electricity was produced in each case, but that when the wire was hot the galvanometer showed that less electricity was passing in the circuit, you would justly say that you had evidence that electricity really disappeared as heat appeared. But should you by chance find that the quantity of zinc dissolved was always in proportion to the current indicated by the galvanometer, then this evidence would be wanting, and the heated wire would only have done in reducing the current what was due to a little additional resistance, that, in fact, due to its heated condition.

We trust that we have now indicated the kind of experiment we should like to see the student make. We have suggested doubts and difficulties, because it is our object to unsettle the student's beliefs, in order that he may the better establish himself in them, than to clear away difficulties from his path or to resolve any of his doubts for him.

In conclusion, we would impress upon our students the desirability of being brief and clear. We do not want them to be mathematical in their papers. Faraday reasoned without mathematical symbols, and our students cannot follow a better or greater example.

French Association for the Advancement of Science.—We learn from *Les Mondes* that, at the meeting to be held at Lyons on the 21st inst., the following papers of electrical interest are to be read:—'An Electro-Diapason,' by M. Mercadier; and 'On the Influence of Metallic Deposits on Zinc in Presence of Acids and Alkalies,' by Professor Gourdon. Papers of collateral interest are to be read by M. Davillé, of the Administration of Telegraph Lines, Bordeaux, by Professor Cornu, and by Colonel Laussedat.

The telegraph cable between the island of Cuba and Porto Rico is in working order again.

---

* In distinguishing the two electrical states, Franklin called that of glass, after being rubbed with a cloth, *positive;* and the opposite state—that of the cloth—*negative.* These terms—positive and negative—although they are still retained to distinguish the opposite electrical states of two bodies after mutual electrical excitation, must not be accepted as indicating the actually *plus* and *minus* conditions of the electricity of bodies, which, for aught we know to the contrary, may exist in the inverted order. That is to say, the electrical condition which we call "negative" may, in reality, be at a higher potential, and the condition we call "positive," at a lower potential, than the earth.

A GEOMETRICAL SOLUTION OF SOME ELECTRICAL PROBLEMS.*

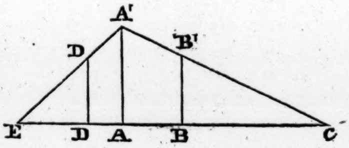
By Prof. EDWARD PICKERING.

THE analytical solution of the following problems is always a little complex, considering the simplicity of the results, and therefore unsatisfactory to the student. It is hoped that the following geometrical method may prove both useful for purposes of instruction and suggestive of a simple solution of other more difficult problems.

The method employed is to represent by horizontal distances or abscissæ, electrical resistances, and by ordinates, the potentials of the various parts of an electrical circuit. Thus, in Fig. 1, neglecting the lines to the left of AA', suppose AC equals the total resistance of the circuit, and that the battery has a potential AA'. If, then, one pole is connected with A, and the other with the ground at C, the potential of any point, B, may be found by drawing the straight line $A'C$, and erecting the perpendicular BB'.

I. *Wheatstone's Bridge.*—Four resistances, M, N, O, and P, are connected together, end to end, two opposite junctions being connected with the poles of a battery, and the other two with a galvanometer. The needle of the latter will not be deflected when $M : N = P : O$. To prove this, lay off (Fig. 1)

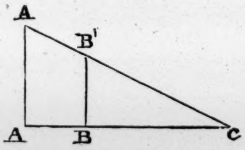
FIG. 1.



$AB = M$, $BC = N$, $ED = O$, and $DA = P$. Suppose the battery connected at A, erect the perpendicular AA' equal to its potential, and draw the lines AC and AE. Draw also the lines BB' and DD'. They will represent the potentials at the terminals of the galvanometer, and will be equal if no current passes. But $AA' : BB' = M + N : N$ and $AA' : DD' = P + O : O$, and if $BB' = DD'$, $M + N : N = P + O : O$, hence $M : N = P : O$.

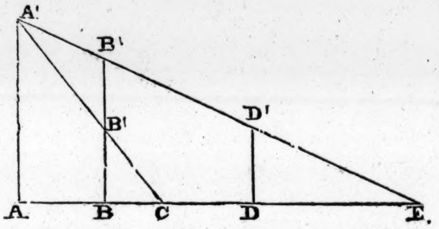
II. *Poggendorff's Methods of Measuring Potentials.*—Let E' equal the potential of the battery to be tested, and E the potential of that with which it is to be compared, and which is taken as a standard. The galvanometer is connected with the latter battery, interposing a resistance to reduce the current. Now connect the two terminals of the other battery with the galvanometer, so as to pass a current through it in the opposite direction, and vary the interposed resistance until the needle comes to zero. Call G the resistance of the galvanometer, and R that of the standard battery and resistance; then there will be equilibrium when $E : E' = G + R : G$. To prove this, let AA' (Fig. 2), equal E, $AB = R$, and $BC = G$. Let DD' also equal E'. For equilibrium DD' must be equal and opposite to BB'. But $AA' : BB' = AC : BC$, or $E : E' = G + R : G$.

FIG. 2.



III. *Thomson's Method of Measuring the Resistance of a Battery.*—This method, although much more recent than the others, is scarcely of less importance. The galvanometer is connected with the battery, and a resistance, R, interposed, to reduce the deflection. R is then removed, and the galvanometer shunted, until precisely the same deflection is again produced. Call B the resistance of the battery, R' that of the shunt, and G that of the galvanometer. Then $B = \frac{RR'}{G}$. In Fig. 3, let AA' equal the potential of the battery, $AB = B$, $BD = R$, $DE = G$. The current passing through the galvanometer will then, in the first case, be measured by DD'. When the galvanometer is shunted its resistance is reduced $\frac{GR'}{G+R'}$. Lay off BC equal to this quantity. The current in the second case evidently equals BB', and since the deflection is the same in both cases, we must have $DD' = BB'$. Now $AA' - DD' : DD' = B + R : G$ and $AA' - BB' : BB' = B : \frac{GR'}{G+R'}$. Hence $B + R : G = B : \frac{GR'}{G+R'}$, or $GB\ (G + R')$ $GR\ (B + R)$, $G^2 B + GBR' = GBR' + GRR'$ and $GB = RR'$. Hence $B = \frac{RR'}{G}$.

FIG. 3.



In the same way the deflection which will be produced in any given case may be determined, or the resistance which should be inserted to render it a maximum. The many applications of this method are, however, so obvious that further illustration seems unnecessary.

THE INTERCOLONIAL CABLE.—An agreement for the construction of a cable from New Zealand to New South Wales, and from Normantown to Singapore, has been signed by the conference representatives of New South Wales, Queensland, and New Zealand. The agreement is to the effect that these colonies shall guarantee five per cent upon one million pounds for thirty-five years, on condition that the cables are constructed for that sum. Receipts of over twelve thousand pounds go to reduce the guarantee. The arrangement will effect a reduction of thirty per cent on the rates charged for messages *via* Singapore, as compared with the Java cable rates. Mr. Audley Coote, agent for the Indo-European, Atlantic, and other leading telegraphic companies interested in the construction of the cable, has been instructed to accept the proposals of the delegates for the construction of the line. The tariff of charges is as follows:—From New Zealand to New South Wales, not to exceed 15s. for twenty words, and 9d. for each additional word; from Normantown to Singapore, 40s. for twenty words, and 2s. for each additional word.

---

* "The Journal of the Franklin Institute," vol. xcvi., No. 570.

MATHEMATICS
FOR
NON-MATHEMATICIANS.

By WILLIAM PAGET HIGGS, LL.D., D.Sc.

DIVISION I.—THE ALGEBRA OF CONSTANT QUANTITIES.

(Continued from p. 222.)

Logarithms (continued).

BEFORE we proceed to the indices of intermediate numbers, we will first apply our deductions to the numbers with which, as logarithms, we are already acquainted.

Logs.	0	1	2	3	4	5	6
Nos.	1	10	100	1000	10,000	100,000	1,000,000

Rule I.—The sum of the $\left\{\begin{matrix}\text{logarithms}\\ \text{exponents}\end{matrix}\right\}$ of two numbers is equal to the $\left\{\begin{matrix}\text{logarithm}\\ \text{exponent}\end{matrix}\right\}$ of their product.

Rule II.—The difference of the $\left\{\begin{matrix}\text{exponents}\\ \text{logarithms}\end{matrix}\right\}$ of two numbers is equal to the $\left\{\begin{matrix}\text{exponent}\\ \text{logarithm}\end{matrix}\right\}$ of the quotient[*] of these numbers.

Rule III.—The $\left\{\begin{matrix}\text{logarithm}\\ \text{exponent}\end{matrix}\right\}$ of the nth power of a number is equal to n times the $\left\{\begin{matrix}\text{logarithm}\\ \text{exponent}\end{matrix}\right\}$ of the number.

Rule IV.—The $\left\{\begin{matrix}\text{logarithm}\\ \text{exponent}\end{matrix}\right\}$ of the nth root of a number is equal to the nth part of the $\left\{\begin{matrix}\text{exponent}\\ \text{logarithm}\end{matrix}\right\}$ of the number.

These rules comprehend the entire use of logarithmic tables, and we will now proceed to their application.

Example to Rule I.—

$$\begin{array}{ll} \text{Log.}\quad 100=2 & \\ \text{Log.}\quad 1000=3 & 100\times 1000=100{,}000. \\ \hline \text{Log.}\ 100{,}000=5 & \end{array}$$

Example to Rule II.—Log. 100 = 2. Log. 100,000 = 5. Five less two = 3, and three is the log. of 1000; 100,000 divided by 100 gives 1000.

Example to Rule III.—The third power of 10 is 1000. Three times the log. of 10 (or 3×1) is the log. of 1000.

Example to Rule IV.—The cube root of 1000 is 10. The result of dividing the log. of 1000 (or 3) by 3 is 1, the log. of 10.

The examples will appear to the student to be self-evident, and it may be thought that logarithms afford only a tedious method of doing what might be more easily done by other rules. But it should be remembered that in practice far more difficult numbers occur than it would be wise to select for illustration.

Having mastered the use of logarithms as integral numbers, we have to deal with the logarithms of those numbers intermediate to 1 and 10, 10 and 100, 100 and 1000, &c. The logarithms of those numbers between 1 and 10 must, it has been shown, be a fraction less than 1, because the log. of 10 is only 1. Between 10 and 100 the log. of the intermediate numbers is 1 plus a fraction; between 100 and 1000 the log. is 2 plus a fraction, and so on; because 10 (the base) must be raised to the second-plus-a-fraction-power to give a number higher than 100.

The integral portion of the logarithms of higher numbers than 10 is termed the *characteristic* of the logarithm, and the fractional portion is termed the *mantissa.*[*] In logarithmic tables generally the characteristics are omitted, because it is easy for the calculator to find them by the obvious rule that "*the characteristic of the logarithm of a number is always* ONE LESS *than the number of integral figures of the number.*" This will be seen in the following table of logarithms of numbers from 1 to 20, whence, if we take the log. of 19 (which is 1·27875), we shall find the characteristic[†] 1 is one less than the number (2) of integers contained in 19.

TABLE OF LOGARITHMS OF NUMBERS FROM 1 TO 20.[‡]

No.	Log.	Arithmetical Complement.
1	0·00000	0·00000
2	0·30103	0·69897
3	0·47712	0·52288
4	0·60206	0·39794
5	0·69897	0·30103
6	0·77815	0·22185
7	0·84510	0·15490
8	0·90309	0·09691
9	0·95424	0·04576
10	1·00000	0·00000
11	1·04139	0·95861
12	1·07918	0·92082
13	1·11394	0·88606
14	1·14613	0·85387
15	1·17609	0·82391
16	1·20412	0·79588
17	1·23045	0·76955
18	1·25527	0·74473
19	1·27875	0·72125
20	1·30103	0·69897

The student will notice that the log. of 20 is, as far as the mantissa is concerned, the same as the logarithm for 2, and this arises from the fact that 2 bears the same ratio to 10 as 20 does to 100. Similarly the log. of 200 is 2·30103; of 150, 2·17609. He will notice, too, the column headed Arithmetical Complement. The arithmetical complement of a log. is the difference of the mantissa of that log. from unity. The use we shall describe presently. Let us now apply to various examples our four rules previously given.

Rule I. *Example.*—To multiply 90 and 120.

$$\begin{array}{rl} \text{Log.}\ \ 90 = & 1{\cdot}95424 \\ \text{,,}\ \ 120 = & 2{\cdot}07918 \\ \hline \text{Log.}\ 10800 = & 4{\cdot}03342 \end{array}$$

A result which the student may verify by reference to a table.

Rule II. *Example.*—To divide 418 by 2·4. The log. of 2·4 is 0·38021, the characteristic being 0, because there is only one integer in the number;

---

[*] Or result of division.

[*] A Latin word, meaning an additional handful, something over and above. Plural "mantissæ."

[†] The characteristic is also termed the index.

[‡] We do not include in these lessons an extended or practical table of logarithms, because such a table would absorb valuable space, and is rendered unnecessary by the many excellent pocket and other tables published at a low price.

but the student looks for the log of 24 in the table.

Log. 418=2·62118. The difference between the two logarithms is 2·24097, the log. of 174·16.

It is a law that (as we shall see when we study the subject of division) to divide by any number n is productive of the same result as to multiply by its reciprocal $\frac{1}{n}$. So it follows that to subtract log. n produces the same result as to add log. $\frac{1}{n} = 0 - \log. n$. Thus we have a reason for the use of the arithmetical complement. And if we substitute for the log. of the divisor its arithmetical complement, then adding instead of subtracting, we arrive at a similar result.

$$\begin{array}{rl} \text{Log. } 418 = & 2\cdot62118 \\ \text{A. C. of } 2\cdot4 = & \bar{1}\cdot61979 \\ \hline \text{Log. } 174\cdot16 = & 2\cdot24097 \end{array}$$

This step introduces to our notice the expression $\bar{1}$, or that of a *negative* characteristic; and this again leads us to treat of logarithms of numbers less than unity. The logarithm of a fraction or a number less than unity must possess a negative characteristic; for as the log. of 10 is 1, the log. of 0·1 or $\frac{1}{10}$ is 10^{-1}, and of 0·01 or $\frac{1}{100}$ or $\frac{1}{10^2}$ is 10^{-2}, according to the rule given on p. 221, which states that a "quantity raised to a negative power is equal to the reciprocal of the positive power of that quantity; or $x^{-n} = \frac{1}{x^n}$, whatever number n may stand for. Therefore the exponent or logarithm of a fraction is negative, and for numbers—

Between	1	and	0·1	lies between	0	and	-1,
,,	0·1	,,	0·01	,,	-1	,,	-2,
,,	0·01	,,	0·001	,,	-2	,,	-3,

&c.

Hence the following rule:—If the decimal be in the first, second, or third or nth place to the right, the characteristic will be $\bar{1}$, $\bar{2}$, or $\bar{3}$ or $\bar{n}$. Thus in the tables the mantissa of the log. of 275 is 0·43933; and—

$$\begin{array}{r} \log. 275 = 2\cdot43933, \\ \log. 27\cdot5 = 1\cdot43933, \\ \log. 2\cdot75 = 0\cdot43933, \\ \log. 0\cdot275 = \bar{1}\cdot43933, \\ \log. 0\cdot0275 = \bar{2}\cdot43933, \\ \log. 0\cdot00275 = \bar{3}\cdot43933. \end{array}$$

From this we can clearly understand that the multiplication of a number by any power of 10 affects the characteristic only of the logarithm, and not the mantissa. And from what has gone before it will appear that given a table of the logarithms of prime numbers* it would be easy to calculate all the logarithms of composite numbers.

The calculations with negative indices are made by the rules of algebra. Thus, if it were required to add two of the logarithms given above,—as 2·43933 and $\bar{3}\cdot43933$,—we add first the mantissæ, and obtain 0·87866, and then prefix the result of adding 2 to $\bar{3}$, viz., $\bar{1}$. $\bar{1}\cdot87866$ is the log. of 0·75625. As examples of multiplying and dividing with negative characteristics, we may select the following:—

To multiply $\bar{3}\cdot43933$ by 5.

$$\begin{array}{r} \bar{3}\cdot43933 \\ 5 \\ \hline \overline{13}\cdot19665 \end{array}$$

The 2 carried on from the last multiplication of the mantissa is added to the -15, and the result $(-15+2) = -13$, the logarithm of a very small fraction.

To divide $\overline{13}\cdot19665$ by 5.

The most ready method of division will be to increase the negative characteristic so that it may be an exact multiple of 5, and compensating for the increase, thus:—

$\overline{13}\cdot19665 = \overline{15} + 2\cdot19665$, and this divided by 5 gives $\bar{3} + 0\cdot43933$ or $\bar{3}\cdot43933$.

We may add to these examples illustrations of Rules III. and IV. as to the process of involution and evolution, or the finding of powers and roots by means of logarithms.

Example to Rule III.—Required the 6th power of 18.

$$\begin{array}{rl} \text{Log. } 18 = & 1\cdot25527 \\ & 6 \\ \hline & 7\cdot53162 = \text{log. } 34{,}012{,}224. \end{array}$$

Required the 6th root of 34,012,224.

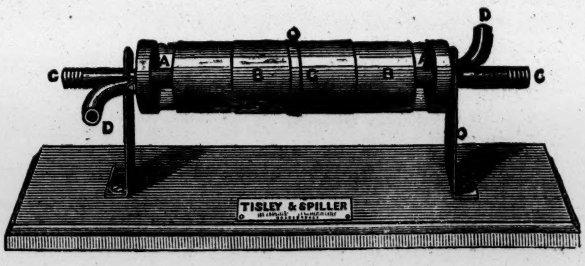
$$6\,)\,\underline{7\cdot53162} = \text{log. } 34{,}012{,}224.$$
$$1\cdot25527 = \text{log. } 18.$$

Next we shall proceed to the consideration of methods of extending the use of ordinary logarithmic tables, and to explain how a system of logarithms calculated to a base, b, may be re-calculated to another base, B.

AN IMPROVED FORM OF OZONE GENERATOR.

Mr. Tisley, of the firm of Tisley and Spiller, has designed a new ozone generator presenting considerable improvements. The generators commonly employed in our laboratories usually take the form of that known as "Siemens's tube" or "Beanes's" generator, and lately that of Boillot has been much used. Brodie's modification of Siemens's tube consisted of two glass tubes closed at one end, and sliding one within the other. In the inter-annular space the ozone was generated, the electrodes being water contained in the inner tube and in an outer vessel in which the tubes were placed. Following

Fig. 4.



---

* A prime or prime number is a number that cannot be divided except by itself or by unity without a remainder: 5, 13, 17, 19, 61, &c., are primes.

this model Messrs. Tisley and Spiller have succeeded in producing a generator of simple and strong construction. The modifications, it will be seen from the following description, are important.

A A is a piece of glass tube, of a little more than an inch in diameter, and of as uniform a bore as can be obtained. On each end of this tube is placed a brass cap, bored with two holes, and coated internally with shellac: in the interior of this glass tube, and of a diameter scarcely less than that of the tube itself, but not quite so long, is placed a thin hollow brass box, B B, with its surface made as true as possible by turning in a lathe: this brass box is placed concentrically with the outer tube, and is completely coated on its exterior surface with tin, the tin being acted upon to the smallest extent by the ozone. This hollow box communicates with the exterior of the apparatus by means of the tubes, C C, passing through the centre of the caps. It is intended that a current of water shall be kept circulating through the interior of this box, the water being brought into direct contact with its sides by means of a small spiral placed within it, the box being of a slightly less diameter than the glass tube; a small annular space will remain between the two, and through this space the gas to be ozonised is passed by means of the tubes, D D; the box itself is made one of the electrified surfaces, and a strip of tin-foil, G, fixed to the outside of the glass tube, forms the other; two binding-screws, E and F, serve to make the necessary connections with an induction-coil. The water may be kept cool by means of ice.

This instrument is much better adapted to the purposes of the lecture table than that of Brodie, whilst it is at the same time more easily worked. Abundance of ozone can be generated with an induction-coil giving a half-inch spark only.

We shall be glad to hear of the construction of larger forms of this instrument, which physicists will find very useful in their study of the properties of ozone.

HINTS FOR USING THE CALLAUD BATTERY.—In using the Callaud battery for telegraphic purposes, it often happens that the connecting wires are eaten off by its energetic action. The remedy, says the *Telegrapher*, is to attach the wire at the bottom of the copper plate, and have gutta-percha to protect it all the way down to its lowest point. When oil is used on the surface of this battery to prevent evaporation, the zincs may be readily cleaned—of the deposit of black oxide with which the oil combines—by dipping them in a solution of caustic soda and water, and scrubbing them with a common battery brush. It is a good plan in telegraph offices to place the Callaud locals in a case with shelves and glass doors, on the walls of the room, some 4 or 5 feet from the floor, in order that they may always be in plain sight.

THE Mexican telegraph line between Minatitlan Vera Cruz has been completed.

REMARKABLE ELECTRICAL PROPERTY OF GLYCERINE.—Professor Waltenhofen finds that when a card is coated with glycerine on one side, and points connected with conductors leading to the coatings of a Leyden jar, or the terminals of a Ruhmkorff coil, are placed in contact with opposite sides, but not exactly opposite each other, the positive in contact with the coated side, the perforation by the discharge will invariably be opposite to the positive point instead of the negative, as in Lullin's experiment.

Students' Column.

Electrification of Dielectrics.

WHEN a battery is connected with the conductor of an insulated cable, the current which flows into it is observed to decrease from the first moment of contact, until finally, after an hour or so, it arrives at an apparently constant value.

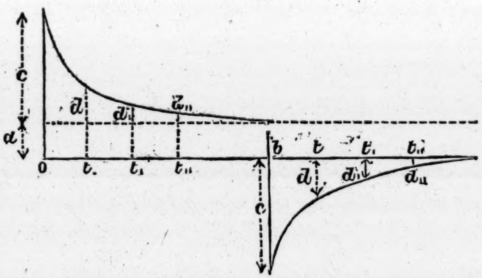
The attention of Mr. Willoughby Smith was first called to this fact during the manufacture of the (1858) Atlantic Cable. Subsequently (1859), quantitative measurements of the apparent increase of resistance due to this so-called electrification, were made at Mr. R. S. Newall's manufactory, at Gateshead, by Mr. Fleeming Jenkin.

The first rush of electricity into a cable core is due to three causes:—

(1). The electrostatic charge;
(2). Electrification or absorption; and,
(3). Leakage through the insulator.

The electrostatic charge lasts only an instant, and its amount depends, other things being equal, upon the ratio between the thickness of the conductor and of the insulator. The electrification, or absorption, at first great, diminishes rapidly, and ceases apparently altogether after some hours. The leakage, however, is constant. In comparing the relative values of these three sources of currents by means of a galvanometer, it is necessary to connect its poles by a shunt in reading the charge, after which the shunt may be removed, and the diminishing deflection due to electrification and leakage observed. After some hours, the electrification being complete, the deflection becomes permanent, and we get the true conductivity of the insulator. If we now remove the battery, and allow the electricity which is within the cable to pass out, through the galvanometer to earth, we get a very high deflection at first on the other side, and this gradually diminishes to zero. The curve obtained by this experiment is shown very roughly in Fig. 5,*

FIG. 5.



The ordinates represent the observed currents, the abscissæ the times after contact. At the point, *o*, the battery being connected to the cable gives the deflection $(a+c)$, due to all three causes—charge, electrification, and leakage—combined. Further on, after an interval, t, the deflection $(d+a)$ is due to electrification and leakage. After t_1, it would be a, due only to leakage. After an interval, b, the battery is removed, and the needle is deflected to the negative side. At the first instant it is $-c$; after an interval, t, from the removal of the battery it is $-d$; and after t', it is $-d'$. Thus we find that (independently of the leakage) the electrification and dis-electrification of a cable go on at the same rate. This rate of course varies greatly with different materials, and with their temperatures and pressures.

---

* Taken from Clark and Sabine's "Tables and Formulæ," p. 71.

In the following table, column 1 gives the times of observation; columns 2 and 5 the rate of influx due to electrification and leakage; columns 3 and 6 the corresponding rate of efflux of the current, due to dis-electrification; and columns 4 and 7 the difference between them, or the current due to leakage alone. These observations were made by Mr. Latimer Clark upon a knot length of French Atlantic core:—

Observation made after minutes.		Series I. at 12° C.			Series II. at 24° C.		
		a. Current flowing into cable from battery.	b. Current flowing out of cable to earth.	a—b Difference due to leakage.	a. Current flowing into cable from battery.	b. Current flowing out of cable to earth.	a—b Difference due to leakage.
1.		2.	3.	4.	5.	6.	7.
1	..	57·8	25·30	34·5	271	74·0	197
2	..	53·8	19·20	34·6	251	54·0	197
3	..	51·0	16·40	34·6	239	42·5	197
4	..	48·9	14·60	34·3	231	35·0	196
5	..	47·7	13·50	34·2	226	30·0	196
6	..	46·7	12·60	34·1	222	25·0	197
8	..	45·1	11·00	34·1	216	20·0	196
10	..	44·0	10·00	34·0	212	16·5	196
12	..	43·0	9·10	33·9	210	14·0	196
14	..	42·6	8·30	34·3	207	11·5	196
16	..	41·6	7·65	34·0	206	10·0	196
18	..	41·0	7·00	34·0	205	9·0	196
20	..	40·7	6·70	34·0	203	7·5	196
25	..	39·6	5·80	33·8	202	5·5	197
30	..	38·7	5·00	33·7	200	4·5	196
40	..	37·4	4·10	33·3	199	3·0	196
50	..	36·6	3·10	33·5	197	2·2	195
60	..	35·8	3·00	32·8	196	1·5	195

The values in columns 2 and 5 are the direct readings of the galvanometer scale at the times given in column 1, after the application of the battery. Those in columns 3 and 6 were obtained by allowing the battery to completely electrify the cable during twelve hours, and then observing the rate at which the current flowed out.

The time during which the electrification goes on has a material effect upon the rate at which dis-electrification takes place. This is evident by the following series of experiments upon the same cable:—

Observations made after.		Current flowing into cable.	Current flowing out of cable after it had been kept to the battery during				
Minutes.			1 min.	2 min.	5 min.	10 min.	12 hrs.
1	...	284·0	23	33	48	63	77
2	...	263·0	13	19	30	43	56
3	...	251·0	—	13	21	32	45
4	...	244·0	7	10	15	25	37
5	...	238·0	3	7	14	21	31
6	...	234·0	—	6	12	17	28
8	...	226·5	—	4	9	13	23
10	...	222·0	—	3	6	9	18

A cable electrified during one minute is apparently completely discharged after ten minutes, whilst a cable charged during twelve hours gives an observable discharge current after an hour. In observing the rate of dis-electrification, therefore, it is necessary first to have completed the electrification as far as is practicable.

The following table contains the insulation resistances of a knot of French Atlantic (1869) core at intervals during one hour's electrification at three different temperatures:—

Observations made after.	Apparent Insulation Resistance.		
	At 0° C.	At 12° C.	At 24° C.
1. Minutes.	2. Megohms.	3. Megohms.	4. Megohms.
1	7,540	1,666	369
2	9,650	1,860	399
3	10,900	1,960	419
4	11,900	2,045	433
5	12,300	2,100	443
6	12,700	2,150	451
8	13,370	2,220	463
10	14,400	2,275	472
12	15,200	2,320	477
14	15,200	2,350	482
16	15,800	2,400	486
18	16,200	2,436	489
20	17,300	2,460	492
25	18,100	2,520	495
30	19,500	2,580	499
35	19,500	2,610	501
40	20,000	2,670	502
45	20,600	2,710	—
50	21,200	2,730	506
55	21,200	2,770	—
60	21,800	2,790	509

The rate at which electrification takes place depends upon the temperature of the cable.—When gutta-percha is cold, its apparent resistance increases in a higher degree after the application of the battery than when it is warm. It would appear from this that the softer the gutta-percha the less it is capable of absorbing electricity, and probably it might be warmed up to a point at which it would show no electrification whatever. This is evident by reference to the above table of measurements of a knot of French Atlantic (1869) core; when at 0° C., its resistance, as appears by column 2, was—

After 1 minute = (7,540) = 100
,, 10 minutes = (14,400) = 191
,, 1 hour = (21,800) = 289

The same coil heated to 12° C., and re-measured, gave the following resistance:—

After 1 minute = (1,666) = 100
,, 10 minutes = (2,275) = 137
,, 1 hour = (2,790) = 167

Showing a considerably lower rate of electrification. But this is still more observable at 24° C. (column 4), at which the same coil had a resistance—

After 1 minute = (369) = 100
,, 10 minutes = (472) = 128
,, 1 hour = (509) = 138

It appears from this that the resistance of gutta-percha, when at a temperature of freezing water, increases in resistance between the one minute and one hour 189 per cent, whereas at 12° C., its resistance increases, in the same time, only 67 per cent; and when heated to 24° C., increases only 38 per cent.

French Telegraphy at the Vienna Exposition.—The telegraphic exhibits include Lenoir's Autographic Telegraph and M. Meyer's Multiple Transmitter, already described in these pages.

PAPERS FOR JUNIOR STUDENTS.

The Old Single Needle and Bain Codes.

In order that the student may compare the code of signals in present use with the codes formerly in use, we extract, from a letter by Mr. Culley to Mr. G. Prescott, as not unlikely to be of use to him, the old single needle and the Bain codes. The advantages of the present, or, as it is termed, Continental system, are sufficiently obvious.

	Old Single Needle.*	Bain.
A.	-	-
B.	- -	- — -
C.	- - -	— - -
D.	- - - -	- - - —
E.	- —	- -
F.	- — —	— —
G.	- — — —	- — - -
H.	- - —	— — —
I.	- - — —	- - -
J.	- - — — —	- - — - -
K.	- - - —	- — — -
L.	- - - — —	- —
M.	- - - - —	- — - —
N.	—	- — —
O.	— —	- - - -
P.	— — —	- - — -
Q.	— — — —	— - — -
R.	— -	—
S.	— — -	— -
T.	— — — -	- - —
U.	— - -	- - - - -
V.	— — - -	— — -
W.	— — — - -	— — - -
X.	— - - —	— - - —
Y.	— — - - -	— - —
Z.	— - - -	— - - -

System of Transmission.

Were the messages handed in by the public at a telegraph office to be allowed to be transmitted as personal or circumstantial caprice might dictate, the result would be confusion. A strict method by which the order of sending may be controlled, and a strict adherence to this method, are almost as essential to speed as a rigid following of the code of signals. We purpose to present to the student the principles adopted for the guidance of the clerks in the State postal telegraphs. The system in actual use will vary in slight detail, but even such slight variation it would of course be unadvisable to sanction officially. The method adopted by our own Administration does not materially differ from that in use on the Continent.

Calling.

When the telegraph was first instituted, and messages were not of very frequent occurrence, the attention of a clerk was called to his instrument by means of an electric bell. But now the frequency of messages renders it necessary that the clerk should be constantly watching his instruments, and also unnecessary that his attention should be advised by any vivid means. There may be said to be two methods of calling—that on the single needle, or Bright's bells, and that on the Morse ink-writer or sounder. Both systems require that the stations on any one line of wire should be known by well-defined names. But as to call or send the name of the station in full every time its attention was required would be a tedious proceeding, very liable to provoke error, the name of a station is generally abbreviated to one or two letters. Thus Manchester is known or called by the letters MR, Liverpool by LV, Telegraph Street —the central station—by TS, &c. These letters we may term the code-name of a station, and proceed to the method of calling employed upon the Single Needle System:—The station who calls repeats upon his instrument the code-name of the station to which it is desired to forward the message, until the latter station acknowledges the call by holding down his right key. The calling station ceases, and the receiving station replies with its own code-name—sent once only. The sending station then gives *its* code-name, in order to inform the receiving station from whence the message is coming. The receiving station repeats the code-name of the sending station once, and the message proceeds.

For example:—Suppose Telegraph Street to call Manchester upon a single needle instrument, the following would be the dialogue:—

> Telegraph Street.—MR, MR - - - - - . MR.
> Manchester (after holding down right-hand key).—MR.
> Telegraph Street.—TS.
> Manchester,—TS.

Morse System of Calling.—First the (CK) call-signal is given, then the code-name of the "station to," next the arbitrary signal V, and finally the code-name of the "station from." Thus, TS would call MR in the following character:—

— - — - — - —   — —   - — -   - - - —   —   - - -

Manchester would reply, after holding down the key for a short period, MR//G—thus:—

— —   - — -   — — -

G being "short" for "Go on."

Code Time.

Speed, it has been remarked, is the essential of telegraphy, and every aid to conciseness is also an aid to the telegraphic system. To telegraph the words "thirty-two minutes past four," even under the time-table form of "four thirty-two," would be too tedious for the telegraphist. He turns to his usual aid to speed—a system of coding. Telegraph code-time is a very simple and neat method. It consists in representing the figures 1 to 12 of the clock by the letters A to M, omitting J: 1 o'clock would thus be represented by A, 5 minutes past 1 by AA, 15 minutes past 1 by AC, ½ past 1 by AF. Intermediate minutes are represented by R S W X, interpolated between every two figures or letter. To represent 7 minutes past 1 we should write AAS, 12 minutes past 1 ABS, and 1.32 AFS, &c.

The Message Form.

Having called his receiver, the telegraph clerk proceeds to signal the code time (if the receiver has a message of prior code-time, that message must be "got off" first), then the total number of words contained in message and address. Next follow the addresses "From" and "To." Then the arbitrary signal DQ, or end of addresses, followed by the body of the message, again succeeded by an arbitrary signal MM, or end of message. The end of the message is in turn succeeded by—

---

* Needle.—Dot to left; dash to right.

Instructions

whether the reply be paid, or how the message is to be transmitted should the addressee reside some distance from a telegraph station. The codes most in use for the purpose of conveying these instructions are the following:—

BB. By Boat.
BC. By Coach or Cab.
BM. By Best Means.
RP. Reply Paid.

The message completed, the receiving clerk "holds over" or holds down his key until he has counted the number of words. This number he telegraphs back, and if it agree with the number sent the sender gives the code RT for right, and proceeds to the next message. If he have not more messages he gives the signal—

·—· ·—· ·—·

Should the number of words be incorrect, and no mistake be apparent, the receiving clerk commences to telegraph back the first word of his message, and the initial letter of each subsequent word. When the omitted or redundant word is thus detected, the sending clerk gives the last correct word, the omitted word or words, and the next word correctly received.

The following, abstracted from Messrs. Clark and Sabine's "Rules for Signalling," will be found also necessary:—

To get a word repeated say—

? w a
··——·· ·—— ·—

"w a" being code for words after.

To signify that you have made an error, give the correction signal (see p. 224), repeat the last correct word, and continue.

To signify wait, give the Signal Wait, ·—··· (or WQ on single needle). If you require to wait for any time send the number of minutes after Wait thus:— 5
·—··· ·····

(Wait five minutes).

Initial letters must be separated by the full stop.

All figures, doubtful words, and unknown proper names in a message, must be repeated back, followed by the note of interrogation. The sending station will reply ···—· if correct, and go on with the next message.

Fractions are sent with the bar of division (see p. 224): thus ½ would be sent—

1 ——— 2
·———— ——————— ··———.

When a station does not read you send the letters—

V V V
···— ···— ···—

to enable him to adjust his apparatus. In a circuit containing one or more translating stations, if there be necessity for calling the attention of those stations to the translators,* give the letter h (····) several times, which is to be understood by the translating clerk to signify that there is something wrong, and requiring his immediate attention.

In single needle, the code signals FI before and IF after the figures are to be used (but not in printing).

The following signals are much used on the Continent, though not officially recognised:—

···—··· Telegraph.
———·———· Drahtanwort.
·· ·— ia for ja or yes, and is used in place of ·—·—·—·—· and ···—·.

Prefix.

The messages received may be divided into two classes:—Those to be delivered by messenger from the office, and those to be re-forwarded by telegraph. The former are distinguished by the prefix S, the latter by the prefix X. The prefix is inserted before code time in the order of the message, so that the clerk may know on which official form the message is to be written. The messages delivered from the office by messenger are taken in manifold, in order to preserve an "office copy." The X-messages it is unnecessary to manifold, because the message form does not leave the office.

We may terminate this paper by an example of a short message in the order in which it would be sent, supposing the receiving station to have been called.

Prefix. *Code Time* (5.15). *No. of Wds.* (20).
··· · —·—· ··— —

F r o m J o
··—· ·—· ——— —— ·——— ———

h n S m i t h
···· —· ··· —— ·· — ····

L o n d o n,
·—·· ——— —· —·· ——— —·

T o M r F .
— ——— —— ·—· ··—· ······

J o n e s B i r
·——— ——— —· · ··· —··· ·· ·—·

n i e S c o t
—· ·· · ··· —·—· ——— —

l a n d. D Q
·—·· ·— —· —·· —·· ——·—

C o m e t o
—·—· ——— —— · — ———

t o w n a t
— ——— ·—— —· ·— —

o n c e .
——— —· —·—· · ······

S a y w h a t
··· ·— —·—— ·—— ···· ·— —

t i m e t r a i n
— ·· —— · — ·—· ·— ·· —·

M M R P Understand.
—— —— ·—· ·——· ···—·

Mr. Thomas Fitch Rowland, the talented American naval engineer, not unknown to telegraphic science, is, we learn from the *New York Coal and Iron Record*, on a visit to England.

New Australian Stations.—Information has been received that two new telegraph stations have been opened on the Australian coast—one at Wilson's Promontory, which has long been required for the shipping between Sydney and Melbourne. Vessels by way of Sydney can now be telegraphed twelve hours before arriving at the Heads. The other station is at Cape Jervis, on the South Australian coast.

---

* An instrument for automatically forwarding a message on to another line, affording fresh battery power. We shall presently describe the instrument.

Obituary.

SIR FRANCIS RONALDS, F.R.S.

The death of Sir Francis Ronalds, F.R.S., on the 8th inst. removes one of the foremost labourers in the field of applied science. The son of the late Mr. Francis Ronalds, he was born in 1788, and thus had attained the advanced age of 85. In a pamphlet published in 1823, he describes an efficient telegraph, in which static electricity was employed. The wire was laid in glass tubes surrounded by wooden troughs lined with pitch, which were placed in a covered ditch in his garden at Hammersmith. There were also eight miles of wire suspended by silk cords hung upon frames. The method of receiving signals depended upon the isochronous movements of two clocks, one at each end of the wire, the clock-work causing a lettered dial to rotate, so that the same letter was presented at the same instant at the two stations. Whether the letter was to be noted or not was indicated by the movement of a pith ball electrometer attached to the wire. In 1870, half a century after his invention, Sir Francis was knighted, "in acknowledgment of his early and remarkable labours in telegraphic investigation." Sir Francis was the original Honorary Director of the Royal Observatory at Kew, and the inventor of various self-registering instruments employed there and at the Royal Observatory, Greenwich, the Radcliffe Observatory, Oxford, and several celebrated foreign observatories. An account of his discoveries will be found in the *Philosophical Magazine*.

Correspondence.

COMPASS DEVIATION.

To the Editor of the Telegraphic Journal.

Sir,—The late unfortunate loss of the *City of Washington* has directed a great deal of attenton to the subject of compass deviation, due to local attraction in iron ships. I have not been fortunate enough to light upon a remedy for this. But it has occurred to me that error caused by recently developed magnetism in the ship might be found and allowed for thus.

If immediately after or at the time of adjusting compasses a pair of well balanced astatic needles be placed, say fore and aft, and their deflection from that position noted, this deflection would indicate the tendency of the magnetic forces contained in the vessel at that time, and would form a standard. In thick weather, when sights could not be taken, or periodically as a precaution, a reading of the astatic needles might be taken, and should the deflection then differ from the standard, the difference would indicate a relative error in the compass.—I am, &c.,

P. Rolls.

Proceedings of Societies.

ACADEMY OF SCIENCES OF VIENNA.

At a late meeting of the Academy, several papers of electrical interest were contributed. M. Stefan confirmed, by numerous experiments on hard caoutchouc, the relations established by Professor Clerk Maxwell between its optical and dielectric properties.

M. Von Lang described a new mirror galvanometer which may be rendered astatic or not at will, masses of copper being employed to deaden or damp the vibrations of the needle. By regulating the degree of damping, and the magnetic action of the auxiliary magnets, a more or less sensitive instrument is obtained, still preserving the aperiodic state of the needle.

M. Domalip contributed a paper on "*The Mechanical Theory of Electrolysis.*" He combats the idea that Ohm's method, according to Bosscha, is much more nearly correct than Poggendorff's method of compensation for the determination of the electro-motive force of a battery calculated according to the chemical effects which take place; for the existence of a current that is never commenced is supposed in the compensated element. M. Domalip wishes to show that polarisation exists even in the most constant batteries, and is an inevitable cause of error in Ohm's method. The method of compensation he considers to furnish a limiting value of the electro-motive force at the moment when the polarisation, which is a function of the intensity of the current, becomes nil in the compensated element. Verifications were made with a chloride of silver element; Poggendorff's method gave concordant results, but Ohm's method showed considerable deviation. The experiments were also repeated with Daniell's, Leclanché's, and Thomson's elements.

Electrical Science in Foreign Journals.

(We intend to devote this column to a list of Electrical Memoirs published in Foreign Journals during the month. Those of importance will be either translated in full or given in abstract.)

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, Vol. lxxvi., No. 2.

Electro-Chemistry.—On the intervention of water in mixtures of saline solutions, neutral, acid, and alkaline.—By M. Becquerel.—The chemical actions which take place in the mixture of saline solutions, acid and alkaline, are accompanied with calorific and electric effects that serve to make known the method of the intervention of water in the effects produced. Calorimetric apparatus give the measure of the quantity of heat disengaged; but in order to determine the intensity of the electric effect produced, it is necessary to evaluate the electromotive force which occurs with the action of water on each of the solutions, and of the solutions one upon the other. The electromotive force in chemical actions is in relation to their greater or less energy. The apparatus employed in the determination of the electromotive forces were the following:—Cracked tubes (described in an earlier number of this Journal, p. 109); a very sensitive galvanometer; two constant elements, formed of couples of amalgamated zinc, pure zinc, a solution of sulphate of zinc perfectly saturated, and a porous porcelain diaphragm. This was the standard, the other element being composed of couples of cadmium, sulphate of cadmium, amalgamated zinc, sulphate of zinc, and porous diaphragm. One of the latter couples was equivalent to about forty-five of the former. The experiments were commenced by ascertaining the electric state of pure water in contact with several saline solutions; and it was found that the water was positive, and consequently played the part of acid with regard to solutions of sulphate of potash, soda, magnesia, baryta, strontium, lime, &c.; but, on the contrary, was negative with regard to solutions of chloride of barium, strontium, magnesium, calcium, &c. In working with a solution of sulphate of ammonia introduced into a cracked tube plunged into distilled water; with a solution of carbonate of soda and distilled water; with the two solutions, one in the cracked tube, the other in the test-tube, the mean of ten experiments gave as the electromotive force—

Sulphate of ammonia	−	18·7
Distilled water	+	
Carbonate of soda ..	−	38·9
Water..	+	
Sulphate of ammonia	+	21·0
Carbonate of soda ..	−	

These results indicate that the electromotive force of the second couple is equal to the sum of the other two; and this law holds good with the subsequent experiments:—

Nitric acid..	+	122·0
Potash	−	
Potash	−	43·0
Water..	+	
Nitric acid..	+	72·0
Water..	−	
Nitric acid..	+	120·0
Ammonia	−	
Nitric acid..	+	70·0
Water..	−	
Ammonia	−	45·0
Water..	+	

M. Becquerel deduces from the facts stated in his memoir the following consequences:—In the mixture of two neutral saline solutions giving place to double decomposition, these decompositions operate by the intervention of the reaction of water on the constituent parts of the salt. In the reaction of acid solutions on alkaline solutions, water is still the principal agent by the intervention of which they commence their action. The affinity of acid for alkali, as anhydrides, plays but a small part in the production of the electromotive force. The researches are to be continued.

On Modification of the Magnetic Power of Steel by Tempering and Annealing.—By M. Jamin.—Having described the method of measurement, of tempering, and annealing, M. Jamin tabulates his results. The table shows that the magnetic power increases in the following order:—Heated to redness, tempered to yellow, blue, blue-white, annealed.

Note on Magnetism.—By M. Th. du Moncel.—Replying to M. Gaugain's objection as to originalities in certain experiments, M. du Moncel says:—I have shown that magnets have two kinds of action—a dynamic action, as in the solenoids of Ampère, and a static action, which constitutes the attractive force properly so-called. These two actions, which have a certain connection, may be produced independently one of the other under opposed conditions. The effects of condensation (as to the first statement of which M. Gaugain contests the origin) result from polar action, and are, consequently, unrelated to dynamic action. It is a kind of reflex action exchanged between the armature and the pole acting on the armature, which has for its effect, not the displacing of the magnetism from the end of the magnet (as interpeted by M. Gaugain), but the molecular induction of a greater quantity of magnetism. There result from this effect two consequences. The atomic polarities being excited to excess, the molecular currents possess more energy, and the magnetic solenoid acts with greater intensity. The polarities determining the attraction finding themselves displaced or masked more or less by the reflex action of the armature, all the atomic polarities in the different parts of the magnet are obliged to displace themselves in the same manner in order to preserve their equilibrium, from which results a general enfeeblement of the exterior polarities of the magnet. One of the most curious consequences of magnetic condensation is the retardation which occurs on the current of demagnetisation in a closed magnetic system, when the voltaic current magnetising the system is interrupted. This effect is analogous to that remarked in electric transmission on submarine cables. In these transmissions there exists a dynamic action, which is related to the current transmitted, and a static action, which is represented by the condensation produced across the insulating envelope of the cable. Now these two actions which exist simultaneously give place to different effects, and these by reciprocal influence retard the rapidity of the electric development which has engendered them.

On the Variable Period of the Closing of a Voltaic Circuit.—By M. A. Cazin.—The researches I have undertaken on the thermic effects of magnetism have led me to study the state of different parts of a voltaic circuit containing a bobbin or an electro-magnet. The divergence of opinions on this point has led me to adopt a new experimental method. I will detail the principle of the apparatus constructed for me by M. Ruhmkorff. An oblong weight of about 1 kilog. falls from a height of 1 metre between two vertical guides. The weight carries two insulated metallic pieces. The first is a vertical plate of iron, 40 c.m. in length, of which the superior extremity communicates by a flexible wire with one of the poles of a battery. When the weight falls, this plate enters a tube containing mercury, which is in connection with the other pole. The circuit is closed at the moment the plate encounters the mercury, and this moment is determined by the distance from the surface at the origin of movement. This distance can be varied at will by raising or lowering tho mercury. The second piece carried by the weight is a steel spring, which communicates by a flexible wire with a point of the circuit. Another point of the circuit communicates by the intervention of a galvanometer, with an insulated metallic plate, fixed to the base of the apparatus. When the weight falls, the spring touches the fixed plate for an instant (0·0004 sec.), and a temporary shunt (derivation) is established by the galvanometer between the two points of the circuit under consideration. There can also be produced a derivation of invariable duration at a given time after the closing of the circuit, and the interval of time which elapses between the closing of the circuit, and the derivation may be calculated by means of the height of the mercury contained in the tube. In my apparatus a change in height of 1 m.m. corresponds to 0·0002 sec. We will suppose a voltaic circuit containing several parts of the same reduced length, some rectilinear, others wound on bobbins, and one of these parts to be the *interval* of a temporary derivation of constant duration. When this derivation is made some time after the closing of the circuit, and, consequently, in a permanent state of the circuit, the deflection of the needle of the galvanometer placed in the derivation is constant. But this does not occur when the derivation takes place during a variable period of the formation of the circuit. When the interval of derivation (shunt) is rectilinear, the deflection of the galvanometer increases proportionally to the time comprised between the formation of the circuit and the shunt contact. The deflection is a function of the time, which remains the same whatever may be the place of derivation in the circuit and that of the point of closing. When the interval of derivation (shunt) is wound into a coil, the deflection of the galvanometer increases at first rapidly, attains a maximum, then decreases continuously, when we increase the time between the closing of the circuit and the shunt contact. The law of this variation is the same, whatever may be the place of the bobbin and that of the closing contact. The duration of the variable period, evaluated according to one or the other of these methods of procedure is the same. This duration is much increased when iron is inserted in the bobbin. When we vary the length of the interval of derivation, whether on a rectilinear wire, or upon a bobbin, the deflection is proportional to this length. From his experiments M. Cazin establishes the following general proposition:—Let us consider a voltaic circuit as composed of a homogeneous wire presenting rectilinear portions and portions wound in coil. Call V the potential of a point, of which x is the distance from a known point in the circuit, reckoned in the length of the wire; the differential coefficient $\frac{dV}{dx}$ possesses at each instant the same value at different points of the right line; it increases gradually with the time. Remaining also the same at different points of a coiled portion of the circuit, of which the elements are especially subject to equal inductive actions, this coefficient increases at first rapidly with the times, attains a maximum, and decreases continuously until it has the same value as in a rectilinear portion; a permanent condition is then attained. Also, in the variable period of closing the circuit, $\frac{dV}{dx}$ is not a function of the time only; it depends upon x, and upon the manner in which the convolutions are arranged around the point considered. The coefficient is proportional to the intensity of the current i.

No. 3.

Researches on Electric Condensation.—By M. V. Neyreneuf.—Under several circumstances of its use, a condenser formed of a plate of glass is a true electrophorus, giving from its two faces, positive or negative, electricity or both at the same time. We may explain all the ordinary phenomena of condensation by attributing to the insulating plate an exclusive *rôle* in their production. Only one difficulty presents itself—that of the occurrence of free electricity on one of the plates; but it is to be remarked—(1) That this electricity is inconsiderable in quantity; (2) That we can without sensible modification impart, by means of a Holtz machine, free electricity to the two plates at once. The study of the electrophorus is, therefore, the study of the condenser.

Revue Scientifique. July 26, 1873.

Experimental Researches on the Electric Resistance of Metals.—By M. René Benoit—(A thesis for the doctorate of the Faculty of Sciences of Paris). M. Benoit details the most important of the means of measuring the electric resistance of metals, and then proceeds to the original research required by the Faculty as a qualification for the doctorate. His researches have been made with a view to the determination of the effect of temperature upon electrical resistance. One of the main features consists in the construction of a gas furnace by which the metallic wires, of which the resistance was to be measured, were maintained at a uniform temperature. Experiments were made at 8° to 20°, 100°, 300°, 360°, 440°, 880°, with upwards of twenty metals and alloys, to determine the value of the coefficients, a and b, in the formula, $R_t = R_0 (1 + a\,t + b\,t^2)$. The resistances are given in Siemens's units, for wires 1 meter in length and 1 m.m. section.

Journal Telegraphique, Vol. ii., No. 19.

New American Telegraph Wire.—(A Report) By M. Ternant.—There has been for some time in use in the United States a new kind of telegraph wire, termed "American Compound Wire," of which the advantages are, augmentation of conductibility and diminution of weight. Whether these advantages have been attained it will be the aim of this report to discuss. Hitherto iron wire has been that generally employed in telegraphy, and when long distances had to be dealt with, it was usual to increase the diameter of the wire. In America, however, copper has been employed, as from Baltimore to Philadelphia, which was replaced by iron in 1846. The diameter most in favour with American engineers is that of 4 m.m., but in cases where greater conductibility is required, diameters of 4·25, 4·75, and even of 5 m.m. are employed. The last diameter is generally considered too great, but there exists numerous circuits in which the wire has a diameter of 6 m.m. It is evident that the greater support required by poles and by insulators, the larger number of joints and increased difficulty of making them, causes the cost to increase in a much more rapid proportion than the diameter. Messrs. Farmer and Milliken, of Boston, have conceived the idea of augmenting the conductibility of a given diameter by forming the wire of a compound of iron and copper. They first adopted the use of a steel plaited wire surrounded with a coating of copper, but ultimately resolved upon the employment of the form of a round wire. The manufacture is mainly monopolised by the New York Company, who employ steel wire for the base drawn from the best Sheffield plates. When of the right diameter the operation of drawing is discontinued, and the wire immersed in dilute sulphuric acid. Thence it is drawn into a bath of lime-water, where it remains until ready for the bath of molten tin. The copper, the most malleable and best conducting that can be obtained, is prepared in long ribands rolled on the bobbins of a covering machine, whence it is wound on a helix upon the steel wire as it passes through the machine, the coils of the helix being so closely laid that the discovery of a joint is a matter of some little difficulty. The last operations consist in another cleansing of the covered wire, and its passage through a bath of molten tin. The wire is then cooled in lengths of 1600 to 2400 metres, according to the diameter and weight. In a length of 1600 there are about three joints. As to the advantages of economy and conductibility, M. Ternant thinks them established; that of durability in all positions has, of course, to be tested. For use in long spans, across rivers, &c., the wire seems well adapted.

Les Mondes. Vol. xxxi., No. 13.

Electricity from Caoutchouc.—By M. Demoget.—On one of the most humid days that have recently occurred, I chanced to notice that one of the little air-balloons, so common a source of amusement with children, produced, with the least friction, even under the most unfavourable circumstances, an enormous amount of electricity. It occurred to me to utilise this remarkable property in the construction of an electrophorus, by replacing the plate of resin with a membrane of caoutchouc strained on a metallic circle of 0·8 c.m. diameter. The result surpasses my experience. For it is sufficient to rub circularly with the back of the hand upon the lower surface of the membrane, to place it upon a good conductor, and to rub in the same manner the superior surface, in order to obtain, with an insulated metallic disc of 25 c.m. diameter, brilliant sparks of 3 to 5 c.m. length. In the most humid weather the same effects may be produced by previously slightly heating the caoutchouc membrane. It is well known that if two superposed sheets of paper be rubbed by the hand, after being slightly heated, and then separated in the dark, numerous sparks appear. Sheets of paper may, it has been found, replace the cake of resin in an electrophorus, with, of course, less brilliant results.

Mines Accident Preventative Apparatus.—By M. A. Kieffer, Director-General of Telegraph Lines in Brazil. —The two most frequent causes of accident in mines are explosions from fire-damp and the invasion of water. My intention is to provide apparatus that would be able to advertise beforehand the danger of this invasion of fire-damp or of water. The principle of my fire-damp indicator is to reveal at regular intervals the presence of fire-damp in a gallery, and to make the fact instantly known at the surface. To this end there is arranged at the upper portion of each gallery, at the points where fire-damp, from its lighter specific gravity, would naturally accumulate, a closed apparatus with metallic conductors, in which an induction current circulates at determined intervals. Each apparatus bears the number of the gallery where it is situated, and communicates with a corresponding number in a tablet at the mouth of the mine, in view of the person who has charge of the ventilation. The passage of an electric spark in each of the apparatus is regulated by a clockwork movement. When an explosion occurs in one of the apparatus, the person in charge is immediately advertised of the fact by the appearance of the number upon the tablet, and he can then change the ventilating apparatus, and purify the atmosphere of the gallery. The apparatus is arranged to effectually prevent explosion of the surrounding gas. The apparatus for indicating access of water consists of a closed cylinder containing a piston lighter than water. It is placed at the lower part of the mine, and when an influx of water occurs, the piston is raised, electrical contact made, a bell rung, and a number shown at the mouth of the mine.

The Telegrapher. Vol. ix., No. 364.

On the Resistance of Relays.—By C. H. Haskins.—I have explained (see *Telegraphic Journal*, p. 207) the law governing the resistance of relays upon any given line. Granting the law I stated, how can this exact proportion be maintained, especially on railroad lines, where new offices are frequently being opened? As it is impracticable to keep an exact balance of resistance between the relays on a line and the line wire, we must adopt some practical compromise. Have three or four standards of resistance, and equip any given circuit with the relays whose resistance approaches most closely that shown by the application of the law. For instance, you may have five standards for relays:—70—100—125—150—200—and, unless a line is very long, with only two or three offices upon it, some one of these would be very near the desired resistance. And another fact should be remembered—that a relay with a light armature and lever will work freely with less current than one with a heavy armature and lever: because, when the armature lever is in a state of rest, the power required to overcome its inertia and "close the relay" is in direct proportion to the weight to be moved. Therefore, a light armature and lever will close freely with a comparatively feeble current.

A New and Improved Switch Board.—The general features of the switch are so familiar that only a brief description will be necessary, in order to point out the improvements which have been adopted to simplify the operation of changing the loops from one main line to another. Some of the studs are split longitudinally, while the others are of the ordinary pattern. Those that are split have their parts insulated with hard rubber. The right-hand side of one is connected with the left-hand side of the succeeding stud, and also through to those used for connecting the centre pin, and connecting right and left of the stud, the current, taking the relay as a starting-point, passes through the vertical strip out around the loop back to the strip adjoining the stud on the further side, then by a permanent connection on the back of the board to the second loop, through which it can be made to pass by a similar manipulation of the studs to either of the wires coming to the board. On the right-hand side a number of studs are placed, and are so arranged that by use of a plug the loop section of the board may be used for main lines when desired. The advantages claimed for this switch are as follows:—The loops being arranged in the above manner, the operators will more readily notice their position, and can, with greater facility, connect such as are wanted than by the plans heretofore in use. The loop studs being directly in line with each other, the placing of a branch office in connection with the lines can be effected more speedily, and without so much examination of the board, as when they are placed in any other position. This switch was designed by Mr. James B. Yeakle, agent of the Gold and Stock Telegraph Co.'s Baltimore office.

No. 366.

The Eagles Battery.—The cell itself, instead of, as in most other batteries for telegraphic purposes, being of glass, is made of lead, and at the same time forms the negative pole of the battery. In setting up or preparing this battery it is only necessary to put into the lead cells a quantity of sulphate of copper (five pounds of which to each cell is found in practice to be advantageous). Over the sulphate of copper a layer of sawdust about an inch thick should be placed, and the zinc set upon the sawdust, then a sufficient quantity of water to cover the whole is poured into the cell. After standing in closed circuit for a few hours the battery will develope its strength, and is ready for use. If it is desired to obtain immediate action a solution of sulphate of zinc should be used instead of water. To prevent or retard evaporation oil may be poured upon the surface of the fluid. Cells prepared in this way will continue in action for six months or more without renewal or any attention whatever. An experimental cell of this battery was in constant use for a large part of the time on short local circuits for nine months, without re-charging, and at the end of that time was still in good effective condition. About five pounds of sulphate of copper was originally placed in this cell. The size is six inches in diameter and eight inches high, or nearly the same as the ordinary Daniell's local. The internal resistance may be varied to suit circumstances, from below one ohm up to five ohms or more, by varying the thickness of the sawdust layer from one to five inches. From one to two inches is usually about right for a local sounder.

Daily Advertiser and Journal. (Elizabeth, N.J., U.S.A.) July 13.

We were shown a few days ago by A. G. Davies, Superintendent of Telegraph of the Baltimore and Ohio Railroad, some improvements on the instruments in ordinary use. The first of these improvements is a patent wire connection. In all the instruments now in use the connection is made by passing the wire through a small hole in a post provided for that purpose, and then fastening it by means of a screw, the end of which presses down upon the wire. It is not impossible that with this screw the connection might be but partially made, or even not made at all. With the new instrument it is made by means of a metallic button which screws firmly down on the wire, which is wound round a threaded post, thus being sure to make a complete connection at some point of the wire, with no possibility of breaking it. Another improvement is in covering what is known as the "main wire" in the relays with a gutta-percha tube, thus completely protecting it while the relays are being cleaned. The adjusting spring which moves the magnet backward or forward is substituted by a double screw which adjusts the magnet, and then holds it firmly in its place. The keys, too, are furnished with a decided improvement in what is known as the circuit breaker. This is a small spring which, in closing the circuit, presses upon a metallic button, one face of which is slightly oval. The spring, even if the circuit breaker be but slightly pressed toward the key, will touch some portion of the button and thus complete the circuit.

City and Commercial Notes.

The half-yearly meeting of the Mediterranean Extension Telegraph Company, Limited, is convened for the 19th inst., to declare a dividend.

The report of the Submarine Telegraph Company, to be presented on the 19th inst., recommends a dividend at the rate of 17 per cent per annum, which will leave £744 to be carried forward. The paid-up capital is £338,225, and the reserve fund now stands at £48,010. At the corresponding date of last year the distribution was at the rate of 15 per cent per annum.

The first ordinary meeting of the Central American Telegraph Company, Limited, is called for the 21st inst., at which will be submitted a joint-purse arrangement with the Western and Brazilian Telegraph Company, Limited. A special meeting will also be held on the same day to authorise the issue of £100,000 additional capital, divided into 5,000 shares of £20 each, as well as alterations in the articles of association.

At the recent statutory meeting of the Eastern Extension, Australasia, and China Telegraph Company, Limited, the directors' report, which was adopted, showed the gross receipts from the 1st January to the 30th June, 1873, to have amounted to £105,245; and stated that an interim dividend of 3s. per share for the quarter ending March had been paid. It was mentioned that the amalgamation had been successfully carried out without a dissent, and that, with the exception of about 1200, the whole of the shares in the British Indian Extension, China Submarine, and British Australian Telegraph Companies, Limited, have been exchanged for new shares in the above Company.

The Eastern Telegraph Company's traffic receipts for the month of July amounted to £28,975, and to £29,565 in the corresponding period of 1872.

The Eastern Extension, Australasia, and China Telegraph Company's traffic receipts for the month of July amounted to £18,190.

The Stock Exchange Committee have ordered the names of the French Atlantic Cable Company and the Newfoundland Telegraph Company to be taken off the Official List, in consequence of their absorption by the Anglo-American Company.

At a special meeting on the 7th inst. of the Direct United States Cable Company, Limited, a resolution was submitted for altering the course of the cable, so that, instead of going from Ireland to New Hampshire direct, as was intended, it will go from Ireland to Newfoundland. This course is stated to have been taken in consequence of a communication received from the Colonial (Newfoundland) Secretary, announcing the intention of that Government to close the concession of the Newfoundland and London Telegraph Company, when it terminates in 1874. It was affirmed that the Company will then be able to send seventeen words per minute, instead of the nine words estimated by the direct route. The resolution was carried unanimously.

The *Great Northern*, screw steamer, the property of Hooper's Telegraph Works, Limited, Captain Murrell commander, left Gravesend on the evening of the 7th inst. with the shore-end cables belonging to the Western and Brazilian Telegraph Company, to be landed at Para, and which, by a junction with the main cable now being laid by the steamship *Hooper*, will connect that city with Pernambuco by submarine telegraph.

In his Monthly Circular Mr. William Abbott says:—"The announcement that the Peruvian Government have offered to guarantee 5 per cent upon the necessary capital for a cable to connect Peru with Panama, is most important at the present juncture, as it will no doubt lead to an early submerging of a cable that will at once become a very valuable auxiliary to the West India and Panama system. With regard to the Anglo-American New Amalgamated Capital, which is now quoted in the Stock Exchange List, in place of the Old Anglo-American, French Atlantic, and Newfoundland Companies, I may state that the dividend expected, estimated on the earnings of those undertakings for the past year, will be about 8 per cent on the New Stock, and I may also mention that the two warrants from the Newfoundland Company, representing the land rights and the deferred claim for £3 per share capital, are expected to be allotted early next week to the names now on the books of that Company. "I have frequently impressed upon shareholders that what has so far been acccomplished in telegraphy, great as it undoubtedly has been, is really but the foundation of still larger results. Thus, the new 'duplex' system of working, which splits the current of electricity, and enables the operator to send messages through the cables in contrary directions at the same moment, has now been successfully organised by the Eastern Telegraph Company. The able and accomplished electricians of that Company have surmounted all difficulties, and have proved the perfect applicability of the system to submarine telegraphy by practically adapting it to the section of the cables between Lisbon and Gibraltar (330 miles), and Malta and Alexandria (950 miles). As soon as the necessary instruments can be obtained, the electricians, profiting by the experience they have acquired on the shorter cables, fully expect to be able to apply the system also successfully to the longer sections between Malta and Gibraltar (1120 miles), between Suez and Aden (1450 miles), and between Aden and Bombay (1820 miles). It is impossible to overrate the importance of these improvements, for, when perfected, they practically at once double the carrying capacity of all existing submarine cables, a fact which must have a considerable influence upon their value as paying investments."

TELEGRAPH SHARE LIST.

Amount per Share.	Name of Company.	Amount paid up.	Closing Quotations.
£		£	Aug. 14.
Stock	Anglo-American (Limited)	100	91—92
10	Brazilian Submarine	7	2¼—1¾ dis.
10	Cuba	All	9¼—9¾
10	Direct Spanish	9	½dis.—½pm
20	Direct United States Cable	8	—
10	Eastern (Limited)	All	9⅛—9⅜
10	Ditto New	All	8⅞—9⅛
10	Eastern Extn. Australia and China	All	8⅞—9⅛
10	Great Northern	All	9¾—10¼
25	Indo-European	All	16—18
10	Mediterranean Extension (Limited)	All	5½—6
10	Do., 8 per cent Pref...	All	11—12
8	Reuters	All	10½—11½
Stock	Submarine	100	240—250
1	Do., Scrip	All	2⅜—2⅝
10	West India and Panama	All	6¾—7¼
10	Do., 10 per cent Pref.	7½	¾—1¼ pm.
20	Western and Brazilian (Limited) ..	18	6—4 dis.
1000 dls.	West Un. U.S. 7 per cent 1st M.B.	All	91—93
10	Hooper's Telegraph Works	All	13—14
50	India-Rubber and Gutta Percha ..	All	32—33
Cert.	Submarine Cables Trust	100	112—115
12	Telegraph Construction	All	34¼—34¾
100	Ditto Ditto 7 per cent Bonds	100	102—105

Patents.

3666. M. Evans, of Glasgow, Civil Engineer. *A new or improved apparatus or mechanism for signalling in railway trains.* Dated December 4, 1872. The features of novelty constituting this invention consist in effecting signal communications in railway trains by the employment of the motive force of the train for generating electricity, and in the apparatus connected therewith.

3672. A. S. Owen, of London, merchant. *Improved means for obtaining electric currents.* A communication from W. C. Teuchert, of Vienna, in the Empire of Austria. Dated December 4, 1872.

3680. T. Petitjean, of Middlesex, chemist. *Improvements in the production of metallic surfaces and articles of various forms by chemical means, and the electro-deposition of metals, which surfaces or articles are produced either highly polished, dead, or matted, engraved, or otherwise ornamented.* Dated December 5, 1872. This invention relates first to the production of very highly polished or reflective surfaces and articles either flat or varied in form, such surfaces consisting either of gold, silver, platinum, nickel, or other metals, and this part of these improvements is carried out by employing glass moulds or surfaces representing the object or articles to be reproduced by first depositing upon such moulds or surfaces a thin coat of the desired metal required for the outer or polished surface of the object or article it is intended to produce. This thin coating of gold, silver, or other metal, is deposited upon the surface of the glass by means of a chemical solution of the particular metal to be deposited, consisting of a mineral salt or oxide of such metal in combination with one or several alkaline vegetable salts depending upon the particular metal to be deposited, which is afterwards thickened by continuing to deposit a further coating thereon of the same, or an inferior or cheaper metal by electro-deposition. In order to produce objects or articles in metal with a dead or matted surface in accordance with these improvements, glass moulds are employed, the surfaces of which are ground with sand or by other means. Those portions of such glass moulds which are left unground will produce highly-polished surfaces as previously described, and any device or ornamental design engraved or in relief upon or applied to the mould will be reproduced upon the metal surface deposited thereon. In some cases moulds are employed in accordance with this invention composed partly of glass and partly or wholly of other suitable substances, such as stearine or stearic acid, paraffine, sealing-wax, or other like substances or materials which are capable of receiving thin, fine, delicate, and compact deposits of metals from chemical solutions of such metals in the manner previously described.

3701. G. K. Winter, F.R.A.S., of Middlesex. *Improvements in electric telegraphs.* Dated December 6, 1872. This provisional specification states that in order to obtain a high speed on long circuits I employ a method by which the line current is only allowed to pass through the receiving instrument while it is varying in strength, a portion of the line current passing in one direction through the instrument during its increase, and in the reverse direction during its decrease. The provisional specification also describes means of protecting the instrument from lightning, and also of telegraphing both ways at once.

3736. W. R. Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. *An improved insulating compound for telegraphic purposes.* A communication from Zalmon G. Simmons, of Kenosha, Wisconsin, U. S. A. Dated December 9, 1872. This invention relates to a composition of materials producing an insulating compound by means of which a more perfect insulation of telegraphic conductors is obtained than by the ordinary means; this compound is at the same time cheap and durable, and is not easily affected by the action of the weather. This compound is composed of one part coal-tar or its equivalent and two parts charcoal or saw-dust, tan bark, or any other organic body having a fibre and being a poor conductor of electricity and which may be ground or cut up to mix with the tar. The coal-tar is brought to a boiling temperature, when the charcoal is introduced and thoroughly combined with it by agitating the entire mass by any mechanical means. The proportions may be varied.

UNITED STATES.

138,965. H. E. Walter, Richfield Springs, New York. *Electrical burglar alarm.* Dated December 10, 1872. A peculiar arrangement of latch and stop mechanism, in connection with an alarm clock, is under the control of an electro-magnet, so that on the interruption of the electrical circuit by the burglarious opening of a door or window in suitable connection, the armature is released by gravity and the alarm is sounded. A stop operated by the clock prevents the alarm being sounded after a given hour in the morning.

138,855. S. C. Carter, Richmond, Ind. *Electro-magnetic motor.* Dated January 17, 1873. A series of concentric rings carrying coils, and provided with radial arms or poles, acting successively as armatures to each other, has a fixed connecting gear with each, so as to secure a different rate of rotation for each, the outer and slowest of the rings being attached to the central shaft, and the necessary intermissions of the current through the revolving coils being effected by their rotations. The described arrangement of two or more concentric drums, having radial armatures, and furnished with insulated coils, having interrupted contact with one pole and continuous contact with the other pole of the battery, said drums being geared differentially to a common counter shaft.

138,889. R. Henning, Ottawa, Ill. *Telegraph cut out and switch.* Dated February 8, 1873. Two plates insulated from each other, having line and instrument connections, are cut through near their centres so as to break circuit. Insulated button, with two metallic strips on base, pivoted at break, so that by turning it completes circuit to or cuts out the instrument. Ground connected to either plate by switch peg. A switch and cut out formed of two parallel plates, with line, local and ground wire connections, adjustable button and metallic peg.

138,870. T. A. Edison, Newark, New Jersey. *Printing telegraph.* Dated March 13, 1873. Electromotor armatures and shaft can continue to revolve when the pulsator and type wheel are arrested. The type wheel and pulsator both upon the same shaft, and revolved by friction, in combination with the type wheel lever, escapement, and electro-magnet.

138,512. E. A. Merrell, East Lyme, Connecticut. *Insulator for telegraph lines.* Dated October 19, 1872. The telegraph wire is confined in a curved groove in the top of the glass insulator, and a glass cap held in position by a screw bolt secures the wire in its position.

138,869. T. A. Edison, Newark, New Jersey. *Printing telegraph.* Dated October 22, 1872. A stop on the type wheel shaft is so arranged with an adjustable detent as to allow but a certain number of revolutions without the action of the impression lever, but is released each time the said lever is moved. The paper feeding pawl is connected with a slotted link, so as to be lifted before the returning arm is moved back; and a cam like slot in a slide, operated by the printing lever, is so arranged as to move the type wheel one letter forward or backward upon its shaft.

138,602. L. Bastet, New York. *Galvanic battery.* Dated November 18, 1872. A solution of the nitro-hyposulphate of soda in water is used for the outer or positive fluid, dispensing with amalgamation of the zinc plate or cylinder, sulphate of copper with nitrate of soda in diluted sulphuric acid being used for the interior or carbon fluid. 1. An alkaline nitrate, a copper sulphate and sulphuric acid, united to form the negative, combined in a porous cell carbon battery with the nitro-hyposulphate of sodium for a positive, as described, to enable the zinc to be used without amalgamation. 2. The application of a nitro-hyposulphate of sodium or potassium to electric batteries.

139,826. G. W. Shawk, Cleveland, Ohio. *Electric annunciator*. Dated April 11, 1873. Number is on an arm attached to armature, and is exposed by being lifted before an opening when armature is attracted.

139,686. G. M. Mowbray, North Adams, Massachusetts. *Electric fuse*. Dated March 19, 1873. A copper thimble, surrounded with a gutta-percha covering, has a chambered gutta-percha plug or cap, which carries the terminals of the insulated wires, and the explosive compound to be ignited by the spark, the whole being securely cemented together.

Prizes for Electrical Subjects offered by the Society of Arts.—Among the general prizes of gold and silver medals offered by the Society of Arts are the following:—

A Galvanic Element which shall combine the constancy of the Daniell's cell with the low resistance and high electromotive force of a Grove's cell.

An Electric Condenser which shall combine high capacity with small bulk, and small residual charge.

A Sensitive Pocket Galvanometer.—The size should not exceed that of a watch.

To which may be added, as of use in telegraphy,—

A Varnish or coating which can be applied to iron wires so as to protect them against rust, and which shall not be liable to chip off when the wire is bent or rubbed.

Electric Weaving.—To the manufacturer who first practically applies electricity to the production commercially of figured fabrics in the loom.

Telegraphs.—For an economic and permanent means of telegraphing through uninsulated wires, between places not less than 1000 miles apart.

Patented inventions are not excluded from receiving the Society's rewards. The Council reserve to themselves the right of withholding all or any of the above medals or premiums, as the judges may report. The Council is willing to receive communications on subjects not included in the above list. The degree of originality and value of suggested improvements will have material influence on the adjudication of the award. In all cases a full account and description of the invention for which a medal or premium is sought must be sent to the Society. All communications must be written on foolscap paper, on one side only, with an inch and a quarter margin: they must be accompanied by such drawings, models, or specimens, as may be necessary to illustrate the subject. The drawings should be on a sufficiently large scale to be seen from a distance when suspended on the walls of a meeting-room. All communications and articles intended for competition must be delivered, addressed to the Secretary, at the Society's House, free of expense, either on or before the 31st December, 1873 or 1874, except where otherwise stated. In the first case they will be considered during the Session 1873-4; in the second case during the Session 1874-5. Any communication rewarded by the Society, or any paper read at an ordinary meeting, will be considered as the property of the Society. Should the Council delay its publication beyond twelve months after the date of its being rewarded or read, the author will be permitted to take a copy of the same, and to publish it in any way he thinks fit.

Telegraphy in Buenos Ayres.—A few days ago Mr. Burton congratulated President Sarmiento on having 6000 miles of telegraph wire open to public service throughout the Republic. A message can be sent from Buenos Ayres a thousand miles, to the frontiers of Bolivia or Paraguay, for one shilling! A merchant of Tucuman or San Juan can now telegraph to Buenos Ayres and obtain an answer in a couple of hours, for half-a-dollar, instead of writing by letter and waiting ten or twenty days for a reply. The *River Plate News* says:—"Within twelve months the River Plate will be in immediate communication with Europe; the price of messages will be very high, say £10 for ten words, the Brazilian concession allowing the Company to charge 4 dols. per word from Rio to Lisbon. When the Atlantic cable began working the charge was £10 a message, but it soon fell to £5, and gave larger profits: at present we believe it is only £2 for ten words. Although Baron Mauá and his friends have a monopoly from Brazil, it is possible the success of his cable will lead to another being laid down from the River Plate to Europe, especially as the Chilian traffic must pass over our wires. Compare the rates of various countries more remote than ours from England, The tariff for 20 words is, to East Indies, £4 5s.; Japan, £7; Australia, £9 17s. 6d. If we go by distance, the charge for 20 words from Buenos Ayres to London should not be over £5, and we may hope that the Company will see the expediency of putting the rate rather under than over that figure. It must be borne in mind that as soon as the land-wires are completed along the West Coast, from Panama to Valparaiso, we shall be able to send messages *via* Panama, Jamaica, and the United States, to Europe. If the Mauá cable establish anything like a moderate tariff, even the Chilians and Peruvians will prefer sending their messages *via* Buenos Ayres and Brazil, as the speedier and more secure route. A considerable reduction will, no doubt, be allowed for press telegrams, as it will always be somewhat onerous for the new spirited newspaper proprietors that will have to bear all the expense of procuring a daily telegram from London. The difference of four hours in time will enable us to receive London advices up to 9 p.m., which will arrive here by 6 or 7 p.m., before going to press. In a word the Mauá cable will work quite a revolution among the mercantile and editorial world of South America; but however individuals may be incommoded the public will be better served.

Iron Poles in Australia.—The Melbourne *Argus* reports the following news from South Australia:—A party has been despatched under the command of Mr. Richard Knuckey, to the Roper River, North Australia, by steamer, to erect iron poles along the line of the overland telegraph. Poles to the number of 1000 have already been landed there, and more are to be shipped from Melbourne. The party will have to erect 4000 between Elsie Creek and a point thirty miles south of Tennant's Creek. Arrangements have been made for the substitution of iron poles for alternate wooden poles on the section immediately south of Port Darwin. A quantity of poles has been sent inland by teams which started from Port Augusta, and steps have been taken to provision the different stations, some for nearly two years, others for nearly three years.

To Correspondents.

*** The publisher, having received numerous letters complaining of the irregular supply of the Journal by Newsagents, begs to state that it will be sent direct from the Office on the day of publication, post free, on receipt of Annual Subscription of 9s. by Post-Office Order.

The Papers on "Duplex Telegraphy," by Mr. W. H. Preece, will be continued in our next.

Fred.—Mr. Geo. Preece, the Secretary, would give you the information. The rules of the Society provide for such applications. The meetings are held at the Institution of Civil Engineers.

Honours Science Student.—Your letter, which shows a true scientific spirit, shall be discussed as early as possible.